

APPDENDIX A
(09/259,849)

DETAILED ACTION

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

2. Claims 1-7, 12-17, 19-21, 23-25, 27-32, 34-36, 38-41, 56-77, and 186-189 are rejected under 35 U.S.C. 103(a) as being unpatentable over Havemann et al. (U. S. Pat. 6,358,849 B1) in view of Brown et al. (U. S. Pat. 6,168,704 B1)

Regarding claim 1, Havemann et al. discloses a method of forming a conductor that comprises depositing an insulator 122(*col. 3, lines 14-17*) over a planarized surface 120(*col. 2, lines 45-47*); etching a trench having a depth on the insulator 122(*col. 3, lines 24-25*); depositing a barrier layer 150 on the insulator (*col. 3, lines 31-35*); depositing a seed layer 152 directly on the barrier layer (*col. 3, lines 35-40*); depositing a conductor on the seed area by a deposition process (*col. 3, lines 37-40*).

Havemann et al. discloses the claimed invention with the exception of removing the barrier layer and seed layer from selected areas of the insulator, and depositing the conductor by a selective deposition process after removing the barrier layer and the seed layer.

Brown et al. discloses a method of forming a conductor that comprises etching a trench 405 having a depth on an insulator (*col. 6, lines 3-6*); depositing a barrier layer 400A on the insulator (*col. 6, lines 3-6*); depositing a seed layer 400B directly on the barrier layer (*col. 6, lines 3-6*); removing the barrier layer and seed layer from selected areas of the insulator, leaving a seed area (*col. 6, lines 14-23*); and depositing a conductor on the seed area by a selective deposition process after removing the barrier layer and seed layer from selected areas of the insulator wherein the selected areas are directly on a top surface of the insulator (*col. 7, lines 50-59 and Figs. 5F-5H*), wherein a seed area is formed by the removal of the barrier and seed layers *col. 6, lines 14-41*), and the conductor is selectively deposited for the disclosed intended purpose of reducing the manufacturing cost, reducing consumption of electroplating solution and CMP consumables, reducing the amount of post-metallization deposition CMP needed and reducing the amount of hazardous effluents among other advantages as disclosed in *col. 16, lines 42-67, and col. 17, lines 1-24*.

Thus, it would have been obvious to one of ordinary skill in the art at the time the invention was made to remove the barrier layer and the seed layer from selected areas and to deposit the conductor by a selective deposition process only in those areas left after the removal of the barrier layer and the seed layer in the invention of Havemann et al. for the disclosed intended purpose of Brown et al. of reducing the manufacturing cost, reducing consumption of electroplating solution and CMP consumables, reducing the amount of post-metallization deposition CMP needed and

reducing the amount of hazardous effluents as disclosed by Brown et al. in col. 16, lines 42-67 and col. 17, lines 1-24.

Regarding claim 2, Havemann et al. discloses depositing the barrier layer 150 by physical vapor deposition.

Regarding claim 3, Havemann et al. discloses etching the trench to a depth about equal to the depth of the insulator as shown in Fig. 1E.

Regarding claim 4, Havemann et al. discloses a method of forming a conductor that comprises depositing an oxide layer 122 (*col. 3, lines 14-17*) over a planarized surface 120(*col. 2, lines 45-47*); etching a trench on the oxide layer 122(*col. 3, lines 24-25*); depositing a barrier layer 150 on the oxide layer 122 (*col. 3, lines 31-35*); depositing a seed layer 152 on the barrier layer without a layer between the seed layer and the barrier layer (*col. 3, lines 35-40*); depositing a conductor on the seed area by a deposition process(*col. 3, lines 37-40*).

Havemann et al. discloses the claimed invention with the exception of removing the barrier layer and seed layer from selected areas of the oxide layer, and depositing the conductor after removing the barrier layer and the seed layer.

Brown et al. discloses a method of forming a conductor that comprises etching a trench 405 having a depth on an insulator (*col. 6, lines 3-6*); depositing a barrier layer 400A on the insulator (*col. 6, lines 3-6*); depositing a seed layer 400B directly on the barrier layer (*col. 6, lines 3-6*); removing the barrier layer and seed layer from selected areas of the insulator, leaving a seed area (*col. 6, lines 14-23*); and depositing a conductor

on the seed area by a selective deposition process after removing the barrier layer and seed layer from selected areas of the insulator wherein the unused areas are directly on a top surface of the insulator (*col. 7, lines 50-59 and Figs. 5F-5H*), wherein a seed area is formed by the removal of the barrier and seed layers (*col. 6, lines 14-41*), and the conductor is selectively deposited for the disclosed intended purpose of reducing the manufacturing cost, reducing consumption of electroplating solution and CMP consumables, reducing the amount of post-metallization deposition CMP needed and reducing the amount of hazardous effluents among other advantages as disclosed in *col. 16, lines 42-67, and col. 17, lines 1-24*.

Thus, it would have been obvious to one of ordinary skill in the art at the time the invention was made to remove the barrier layer and the seed layer from selected areas and to deposit the conductor by a selective deposition process only in those areas left after the removal of the barrier layer and the seed layer in the invention of Havemann et al. for the disclosed intended purpose of Brown et al. of reducing the manufacturing cost, reducing consumption of electroplating solution and CMP consumables, reducing the amount of post-metallization deposition CMP needed and reducing the amount of hazardous effluents as disclosed by Brown et al. in *col. 16, lines 42-67 and col. 17, lines 1-24*.

Regarding claim 5, Havemann et al. discloses that the oxide layer comprises a silicon dioxide.

Regarding claim 6, Havemann et al. discloses that the oxide layer is a fluorinated silicon oxide layer (*col. 3, ll. 14-16*).

Regarding claim 7, Havemann et al. discloses that the seed layer is deposited on the barrier layer by physical vapor deposition.

Regarding claim 12, Havemann et al. discloses a method of forming a conductor that comprises depositing an oxide layer 122 (*col. 3, lines 14-17*) over a planarized surface 120 (*col. 2, lines 45-47*); etching a trench on the oxide layer 122 (*col. 3, lines 24-25*); depositing a barrier layer 150 of tantalum on the oxide layer 122 (*col. 3, lines 31-35*); depositing a seed layer 152 of copper on the oxide layer (*col. 3, lines 35-40*); depositing a conductor on the seed area by a deposition process (*col. 3, lines 37-40*).

Havemann et al. discloses the claimed invention with the exception of removing the barrier layer and seed layer from selected areas of the oxide layer, and depositing the conductor after removing the barrier layer and the seed layer.

Brown et al. discloses a method of forming a conductor that comprises etching a trench 405 having a depth on an insulator (*col. 6, lines 3-6*); depositing a barrier layer 400A on the insulator (*col. 6, lines 3-6*); depositing a seed layer 400B directly on the barrier layer (*col. 6, lines 3-6*); removing the barrier layer and seed layer from selected areas of the insulator, leaving a seed area (*col. 6, lines 14-23*); and depositing a conductor on the seed area by a selective deposition process after removing the barrier layer and seed layer from selected areas of the insulator wherein the unused areas are directly on a top surface of the insulator (*col. 7, lines 50-59 and Figs. 5F-5H*), wherein a seed area is

formed by the removal of the barrier and seed layers (*col. 6, lines 14-41*), and the conductor is selectively deposited for the disclosed intended purpose of reducing the manufacturing cost, reducing consumption of electroplating solution and CMP consumables, reducing the amount of post-metallization deposition CMP needed and reducing the amount of hazardous effluents among other advantages as disclosed in *col. 16, lines 42-67, and col. 17, lines 1-24*.

Thus, it would have been obvious to one of ordinary skill in the art at the time the invention was made to remove the barrier layer and the seed layer from selected areas and to deposit the conductor by a selective deposition process only in those areas left after the removal of the barrier layer and the seed layer in the invention of Havemann et al. for the disclosed intended purpose of Brown et al. of reducing the manufacturing cost, reducing consumption of electroplating solution and CMP consumables, reducing the amount of post-metallization deposition CMP needed and reducing the amount of hazardous effluents as disclosed by Brown et al. in *col. 16, lines 42-67 and col. 17, lines 1-24*.

Regarding claim 13, Havemann et al. discloses that the barrier layer comprising tantalum is deposited to a thickness of between 100 and 200 angstroms, and the barrier layer does not fill the trench. Although the depth of the trench is not disclosed it is taught that the depth is of at least 200 angstroms and that the depth can be varied depending on the interconnection as shown in Fig. 1k of Havemann et al. Furthermore, it would have been obvious to one of ordinary skill in the art at the time the invention

was made to vary the depth of the trench, thus varying the depth to which the barrier layer is deposited as there is no statement denoting the criticality of the depth to which the barrier layer is deposited.

"In the case where the claimed ranges "overlap or lie inside ranges disclosed by the prior art" a prima facie case of obviousness exists. *In re Wertheim*, 541 F.2d 257, 191 USPQ 90 (CCPA 1976); *In re Woodruff*, 919 F.2d 1575, 16 USPQ2d 1934 (Fed. Cir. 1990) (The prior art taught carbon monoxide concentrations of "about 1-5%" while the claim was limited to "more than 5%." The court held that "about 1-5%" allowed for concentrations slightly above 5% thus the ranges overlapped.)" (MPEP 2144.04)

Regarding claim 14, Havemann et al. discloses in col. 3, lines 31-35 that the barrier layer is deposited by physical vapor deposition.

Regarding claim 15, Havemann et al. discloses a method of forming a conductor that comprises depositing an oxide layer 122 (*col. 3, lines 14-17*) over a planarized surface 120 (*col. 2, lines 45-47*); etching a trench on the oxide layer 122 (*col. 3, lines 24-25*); depositing a barrier layer 150 of tantalum on the oxide layer 122 (*col. 3, lines 31-35*); depositing a seed layer 152 of copper on the oxide layer (*col. 3, lines 35-40*); depositing a conductor on the seed area by a deposition process (*col. 3, lines 37-40*).

Havemann et al. discloses the claimed invention with the exception of removing the barrier layer and seed layer from selected areas of the oxide layer, using gold on the seed layer and the conductor, and depositing the conductor after removing the barrier layer and the seed layer.

Brown et al. discloses a method of forming a conductor that comprises etching a trench 405 having a depth on an insulator (*col. 6, lines 3-6*); depositing a barrier layer

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400A on the insulator (*col. 6, lines 3-6*); depositing a seed layer 400B directly on the barrier layer (*col. 6, lines 3-6*); removing the barrier layer and seed layer from selected areas of the insulator, leaving a seed area (*col. 6, lines 14-23*); and depositing a conductor on the seed area by a selective deposition process after removing the barrier layer and seed layer from selected areas of the insulator wherein the selected areas are directly on a top surface of the insulator (*col. 7, lines 50-59 and Figs. 5F-5H*), and wherein gold, copper, and silver have been considered as alternatives to aluminum; wherein a seed area is formed by the removal of the barrier and seed layers (*col. 6, lines 14-41*), and the conductor is selectively deposited for the disclosed intended purpose of reducing the manufacturing cost, reducing consumption of electroplating solution and CMP consumables, reducing the amount of post-metallization deposition CMP needed and reducing the amount of hazardous effluents among other advantages as disclosed in *col. 16, lines 42-67, and col. 17, lines 1-24*.

Thus, it would have been obvious to one of ordinary skill in the art at the time the invention was made to remove the barrier layer and the seed layer from selected areas and to deposit the conductor by a selective deposition process only in those areas left after the removal of the barrier layer and the seed layer in the invention of Havemann et al. for the disclosed intended purpose of Brown et al. of reducing the manufacturing cost, reducing consumption of electroplating solution and CMP consumables, reducing the amount of post-metallization deposition CMP needed and reducing the amount of hazardous effluents as disclosed by Brown et al. in *col. 16, lines*

42-67 and col. 17, lines 1-24. Furthermore, it would have been within the scope of one of ordinary skill in the art at the time the invention was made that gold may be used as an alternative to copper or aluminum although copper is preferred over gold, and as Brown et al. discloses that the use of gold has been considered in semiconductor interconnections and disclosed examples and preferred embodiments do not constitute a teaching away from a broader disclosure or nonpreferred embodiments.

In re Susi, 440 F.2d 442, 169 USPQ 423 (CCPA 1971). "A known or obvious composition does not become patentable simply because it has been described as somewhat inferior to some other product for the same use." *In re Gurley*, 27 F.3d 551, 554, 31 USPQ2d 1130, 1132 (Fed. Cir. 1994) (The invention was directed to an epoxy impregnated fiber-reinforced printed circuit material. The applied prior art reference taught a printed circuit material similar to that of the claims but impregnated with polyester-imide resin instead of epoxy. The reference, however, disclosed that epoxy was known for this use, but that epoxy impregnated circuit boards have "relatively acceptable dimensional stability" and "some degree of flexibility," but are inferior to circuit boards impregnated with polyester-imide resins. The court upheld the rejection concluding that applicant's argument that the reference teaches away from using epoxy was insufficient to overcome the rejection since "Gurley asserted no discovery beyond what was known in the art." 27 F.3d at 554, 31 USPQ2d at 1132.):

Regarding claim 16, Havemann et al. discloses that the barrier layer comprising tantalum is deposited to a thickness of between 100 and 200 angstroms, and the barrier layer does not fill the trench. Although the depth of the trench is not disclosed it is

taught that the depth is of at least 200 angstroms and that the depth can be varied depending on the interconnection as shown in Fig. 1k of Havemann et al. Furthermore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to vary the depth of the trench, thus varying the depth to which the barrier layer is deposited as there is no statement denoting the criticality of the depth to which the barrier layer is deposited.

"In the case where the claimed ranges "overlap or lie inside ranges disclosed by the prior art" a prima facie case of obviousness exists. In re Wertheim, 541 F.2d 257, 191 USPQ 90 (CCPA 1976); In re Woodruff, 919 F.2d 1575, 16 USPQ2d 1934 (Fed. Cir. 1990) (The prior art taught carbon monoxide concentrations of "about 1-5%" while the claim was limited to "more than 5%." The court held that "about 1-5%" allowed for concentrations slightly above 5% thus the ranges overlapped.)" (MPEP 2144.04)

Regarding claim 17, Havemann et al. discloses in col. 3, lines 31-35 that the barrier layer is deposited by physical vapor deposition.

Regarding claim 19, Havemann et al. discloses a method of forming a conductor that comprises depositing an oxide layer 122 (*col. 3, lines 14-17*) over a planarized surface 120(*col. 2, lines 45-47*); etching a trench on the oxide layer 122(*col. 3, lines 24-25*); depositing a barrier layer 150 of tantalum on the oxide layer 122 (*col. 3, lines 31-35*); depositing a seed layer 152 of copper on the oxide layer (*col. 3, lines 35-40*); depositing a conductor on the seed area by a deposition process (*col. 3, lines 37-40*).

Havemann et al. discloses the claimed invention with the exception of removing the barrier layer and seed layer from selected areas of the oxide layer, using silver on

the seed layer and the conductor, and depositing the conductor after removing the barrier layer and the seed layer.

Brown et al. discloses a method of forming a conductor that comprises etching a trench 405 having a depth on an insulator (*col. 6, lines 3-6*); depositing a barrier layer 400A on the insulator (*col. 6, lines 3-6*); depositing a seed layer 400B directly on the barrier layer (*col. 6, lines 3-6*); removing the barrier layer and seed layer from selected areas of the insulator, leaving a seed area (*col. 6, lines 14-23*); and depositing a conductor on the seed area by a selective deposition process after removing the barrier layer and seed layer from selected areas of the insulator wherein the selected areas are directly on a top surface of the oxide layer (*col. 7, lines 50-59 and Figs. 5F-5H*), and wherein gold, copper, and silver have been considered as alternatives to aluminum; wherein a seed area is formed by the removal of the barrier and seed layers (*col. 6, lines 14-41*), and the conductor is selectively deposited for the disclosed intended purpose of reducing the manufacturing cost, reducing consumption of electroplating solution and CMP consumables, reducing the amount of post-metallization deposition CMP needed and reducing the amount of hazardous effluents among other advantages as disclosed in *col. 16, lines 42-67, and col. 17, lines 1-24*.

Thus, it would have been obvious to one of ordinary skill in the art at the time the invention was made to remove the barrier layer and the seed layer from selected areas and to deposit the conductor by a selective deposition process only in those areas left after the removal of the barrier layer and the seed layer in the invention of

Havemann et al. for the disclosed intended purpose of Brown et al. of reducing the manufacturing cost, reducing consumption of electroplating solution and CMP consumables, reducing the amount of post-metallization deposition CMP needed and reducing the amount of hazardous effluents as disclosed by Brown et al. in col. 16, lines 42-67 and col. 17, lines 1-24. Furthermore, it would have been within the scope of one of ordinary skill in the art at the time the invention was made that silver may be used as an alternative to copper or aluminum although copper is preferred over silver, and as Brown et al. discloses that the use of gold has been considered in semiconductor interconnections and disclosed examples and preferred embodiments do not constitute a teaching away from a broader disclosure or nonpreferred embodiments.

In re Susi, 440 F.2d 442, 169 USPQ 423 (CCPA 1971). "A known or obvious composition does not become patentable simply because it has been described as somewhat inferior to some other product for the same use." *In re Gurley*, 27 F.3d 551, 554, 31 USPQ2d 1130, 1132 (Fed. Cir. 1994) (The invention was directed to an epoxy impregnated fiber-reinforced printed circuit material. The applied prior art reference taught a printed circuit material similar to that of the claims but impregnated with polyester-imide resin instead of epoxy. The reference, however, disclosed that epoxy was known for this use, but that epoxy impregnated circuit boards have "relatively acceptable dimensional stability" and "some degree of flexibility," but are inferior to circuit boards impregnated with polyester-imide resins. The court upheld the rejection concluding that applicant's argument that the reference teaches away

from using epoxy was insufficient to overcome the rejection since "Gurley asserted no discovery beyond what was known in the art." 27 F.3d at 554, 31 USPQ2d at 1132.).

Regarding claim 20, Havemann et al. discloses in col. 3, lines 31-35 that the barrier layer is deposited by physical vapor deposition.

Regarding claim 21, Havemann et al. discloses that the barrier layer comprising tantalum is deposited to a thickness of between 100 and 200 angstroms, and the barrier layer does not fill the trench. Although the depth of the trench is not disclosed it is taught that the depth is of at least 200 angstroms and that the depth can be varied depending on the interconnection as shown in Fig. 1k of Havemann et al. Furthermore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to vary the depth of the trench, thus varying the depth to which the barrier layer is deposited as there is no statement denoting the criticality of the depth to which the barrier layer is deposited.

"In the case where the claimed ranges "overlap or lie inside ranges disclosed by the prior art" a prima facie case of obviousness exists. In re Wertheim, 541 F.2d 257, 191 USPQ 90 (CCPA 1976); In re Woodruff, 919 F.2d 1575, 16 USPQ2d 1934 (Fed. Cir. 1990) (The prior art taught carbon monoxide concentrations of "about 1-5%" while the claim was limited to "more than 5%." The court held that "about 1-5%" allowed for concentrations slightly above 5% thus the ranges overlapped.)" (MPEP 2144.04)

Regarding claim 23, Havemann et al. discloses a method of forming a conductor that comprises depositing an oxide layer 122 (col. 3, lines 14-17) over a planarized surface 120(col. 2, lines 45-47); etching a trench on the oxide layer 122(col. 3, lines 24-25); depositing a barrier layer 150 of tantalum on the oxide layer 122 (col. 3, lines 31-35);

depositing a seed layer 152 of copper on the oxide layer (*col. 3, lines 35-40*); depositing a conductor on the seed area by a deposition process (*col. 3, lines 37-40*).

Havemann et al. discloses the claimed invention with the exception of removing the barrier layer and seed layer from selected areas of the oxide layer, and depositing the conductor after removing the barrier layer and the seed layer.

Brown et al. discloses a method of forming a conductor that comprises etching a trench 405 having a depth on an insulator (*col. 6, lines 3-6*); depositing a barrier layer 400A on the insulator (*col. 6, lines 3-6*); depositing a seed layer 400B directly on the barrier layer (*col. 6, lines 3-6*); removing the barrier layer and seed layer from selected areas of the insulator, leaving a seed area (*col. 6, lines 14-23*); and depositing a conductor on the seed area by a selective deposition process after removing the barrier layer and seed layer from selected areas of the insulator wherein the selected areas are directly on a top surface of the insulator (*col. 7, lines 50-59 and Figs. 5F-5H*), wherein a seed area is formed by the removal of the barrier and seed layers (*col. 6, lines 14-41*), and the conductor is selectively deposited for the disclosed intended purpose of reducing the manufacturing cost, reducing consumption of electroplating solution and CMP consumables, reducing the amount of post-metallization deposition CMP needed and reducing the amount of hazardous effluents among other advantages as disclosed in *col. 16, lines 42-67, and col. 17, lines 1-24*.

Brown et al. discloses a method of forming a conductor that comprises etching a trench 405 having a depth on an insulator (*col. 6, lines 3-6*); depositing a barrier layer

400A on the insulator (*col. 6, lines 3-6*); depositing a seed layer 400B directly on the barrier layer (*col. 6, lines 3-6*); removing the barrier layer and seed layer from selected areas of the insulator, leaving a seed area (*col. 6, lines 14-23*); and depositing a conductor on the seed area by a selective deposition process after removing the barrier layer and seed layer from selected areas of the insulator (*col. 7, lines 50-59*), and wherein gold, copper, silver, and aluminum have been considered as alternatives for conductors; wherein a seed area is formed by the removal of the barrier and seed layers (*col. 6, lines 14-41*), and the conductor is selectively deposited for the disclosed intended purpose of reducing the manufacturing cost, reducing consumption of electroplating solution and CMP consumables, reducing the amount of post-metallization deposition CMP needed and reducing the amount of hazardous effluents among other advantages as disclosed in *col. 16, lines 42-67*, and *col. 17, lines 1-24*.

Thus, it would have been obvious to one of ordinary skill in the art at the time the invention was made to remove the barrier layer and the seed layer from selected areas and to deposit the conductor by a selective deposition process only in those areas left after the removal of the barrier layer and the seed layer in the invention of Havemann et al. for the disclosed intended purpose of Brown et al. of reducing the manufacturing cost, reducing consumption of electroplating solution and CMP consumables, reducing the amount of post-metallization deposition CMP needed and reducing the amount of hazardous effluents as disclosed by Brown et al. in *col. 16, lines 42-67* and *col. 17, lines 1-24*. Furthermore, it would have been within the scope of one of

ordinary skill in the art at the time the invention was made that aluminum may be used as an alternative although copper is preferred over aluminum, and as Brown et al. discloses that the use of gold has been considered in semiconductor interconnections and disclosed examples and preferred embodiments do not constitute a teaching away from a broader disclosure or nonpreferred embodiments.

In re Susi, 440 F.2d 442, 169 USPQ 423 (CCPA 1971). "A known or obvious composition does not become patentable simply because it has been described as somewhat inferior to some other product for the same use." *In re Gurley*, 27 F.3d 551, 554, 31 USPQ2d 1130, 1132 (Fed. Cir. 1994) (The invention was directed to an epoxy impregnated fiber-reinforced printed circuit material. The applied prior art reference taught a printed circuit material similar to that of the claims but impregnated with polyester-imide resin instead of epoxy. The reference, however, disclosed that epoxy was known for this use, but that epoxy impregnated circuit boards have "relatively acceptable dimensional stability" and "some degree of flexibility," but are inferior to circuit boards impregnated with polyester-imide resins. The court upheld the rejection concluding that applicant's argument that the reference teaches away from using epoxy was insufficient to overcome the rejection since "Gurley asserted no discovery beyond what was known in the art." 27 F.3d at 554, 31 USPQ2d at 1132.).

Regarding claim 24, Havemann et al. discloses that the barrier layer comprises titanium and is deposited to a thickness of between 100 and 200 angstroms, and the barrier layer does not fill the trench. Although the depth of the trench is not disclosed it is taught that the depth is of at least 200 angstroms and that the depth can be varied

depending on the interconnection as shown in Fig. 1k of Havemann et al. Furthermore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to vary the depth of the trench, thus varying the depth to which the barrier layer is deposited as there is no statement denoting the criticality of the depth to which the barrier layer is deposited.

"In the case where the claimed ranges "overlap or lie inside ranges disclosed by the prior art" a prima facie case of obviousness exists. In re Wertheim, 541 F.2d 257, 191 USPQ 90 (CCPA 1976); In re Woodruff, 919 F.2d 1575, 16 USPQ2d 1934 (Fed. Cir. 1990) (The prior art taught carbon monoxide concentrations of "about 1-5%" while the claim was limited to "more than 5%." The court held that "about 1-5%" allowed for concentrations slightly above 5% thus the ranges overlapped.)" (MPEP 2144.04)

Regarding claim 25, Havemann et al. discloses in col. 3, lines 31-35 that the barrier layer is deposited by physical vapor deposition.

Regarding claim 27, Havemann et al. discloses a method of forming a conductor that comprises depositing a polymer layer 122(*col. 3, lines 14-17, col. 4, lines 49-65*) over a planarized surface 120(*col. 2, lines 45-47*); etching a trench having a depth on the polymer 122(*col. 3, lines 24-25*); depositing a barrier layer 150 of titanium on the insulator (*col. 3, lines 31-35*); depositing a seed layer of copper 152 directly on the barrier layer (*col. 3, lines 35-40*); depositing a conductor on the seed area by a deposition process (*col. 3, lines 37-40*).

Havemann et al. discloses the claimed invention with the exception of removing the barrier layer and seed layer from selected areas of the insulator, and depositing the

conductor by a selective deposition process after removing the barrier layer and the seed layer.

Brown et al. discloses a method of forming a conductor that comprises etching a trench 405 having a depth on an insulator (*col. 6, lines 3-6*); depositing a barrier layer 400A on the insulator (*col. 6, lines 3-6*); depositing a seed layer 400B directly on the barrier layer (*col. 6, lines 3-6*); removing the barrier layer and seed layer from selected areas of the insulator, leaving a seed area (*col. 6, lines 14-23*); and depositing a conductor on the seed area by a selective deposition process after removing the barrier layer and seed layer from selected areas of the insulator wherein the selected areas are directly on a top surface of the insulator (*col. 7, lines 50-59 and Figs. 5F-5H*), wherein a seed area is formed by the removal of the barrier and seed layers *col. 6, lines 14-41*), and the conductor is selectively deposited for the disclosed intended purpose of reducing the manufacturing cost, reducing consumption of electroplating solution and CMP consumables, reducing the amount of post-metallization deposition CMP needed and reducing the amount of hazardous effluents among other advantages as disclosed in *col. 16, lines 42-67, and col. 17, lines 1-24*.

Thus, it would have been obvious to one of ordinary skill in the art at the time the invention was made to remove the barrier layer and the seed layer from selected areas and to deposit the conductor by a selective deposition process only in those areas left after the removal of the barrier layer and the seed layer in the invention of Havemann et al. for the disclosed intended purpose of Brown et al. of reducing the

manufacturing cost, reducing consumption of electroplating solution and CMP consumables, reducing the amount of post-metallization deposition CMP needed and reducing the amount of hazardous effluents as disclosed by Brown et al. in col. 16, lines 42-67 and col. 17, lines 1-24.

Regarding claim 28, Havemann et al. discloses that the barrier layer comprises titanium and is deposited to a thickness of between 100 and 200 angstroms, and the barrier layer does not fill the trench. Although the depth of the trench is not disclosed it is taught that the depth is of at least 200 angstroms and that the depth can be varied depending on the interconnection as shown in Fig. 1k of Havemann et al. Furthermore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to vary the depth of the trench, thus varying the depth to which the barrier layer is deposited as there is no statement denoting the criticality of the depth to which the barrier layer is deposited.

"In the case where the claimed ranges "overlap or lie inside ranges disclosed by the prior art" a prima facie case of obviousness exists. In re Wertheim, 541 F.2d 257, 191 USPQ 90 (CCPA 1976); In re Woodruff, 919 F.2d 1575, 16 USPQ2d 1934 (Fed. Cir. 1990) (The prior art taught carbon monoxide concentrations of "about 1-5%" while the claim was limited to "more than 5%." The court held that "about 1-5%" allowed for concentrations slightly above 5% thus the ranges overlapped.)" (MPEP 2144.04)

Regarding claim 29, Havemann et al. discloses in col. 3, lines 31-35 that the barrier layer is deposited by physical vapor deposition.

Regarding claim 30, Havemann et al. discloses a method of forming a conductor that comprises depositing a polymer layer 122(col. 3, lines 14-17, col. 4, lines 49-65) over a

planarized surface 120(*col. 2, lines 45-47*); etching a trench having a depth on the polymer 122(*col. 3, lines 24-25*); depositing a barrier layer 150 of titanium on the insulator (*col. 3, lines 31-35*); depositing a seed layer of copper 152 directly on the barrier layer (*col. 3, lines 35-40*); depositing a conductor on the seed area by a deposition process (*col. 3, lines 37-40*).

Havemann et al. discloses the claimed invention with the exception of removing the barrier layer and seed layer from selected areas of the insulator, using gold as the seed layer and conductor, and depositing the conductor by a selective deposition process after removing the barrier layer and the seed layer.

Brown et al. discloses a method of forming a conductor that comprises etching a trench 405 having a depth on an insulator (*col. 6, lines 3-6*); depositing a barrier layer 400A on the insulator (*col. 6, lines 3-6*); depositing a seed layer 400B directly on the barrier layer (*col. 6, lines 3-6*); removing the barrier layer and seed layer from selected areas of the insulator, leaving a seed area (*col. 6, lines 14-23*); and depositing a conductor on the seed area by a selective deposition process after removing the barrier layer and seed layer from selected areas of the insulator wherein the selected areas are directly on a top surface of the insulator (*col. 7, lines 50-59 and Figs. 5F-5H*), and wherein gold, copper, and silver have been considered as alternatives to aluminum; wherein a seed area is formed by the removal of the barrier and seed layers (*col. 6, lines 14-41*), and the conductor is selectively deposited for the disclosed intended purpose of reducing the manufacturing cost, reducing consumption of electroplating solution and CMP

consumables, reducing the amount of post-metallization deposition CMP needed and reducing the amount of hazardous effluents among other advantages as disclosed in col. 16, lines 42-67, and col. 17, lines 1-24.

Thus, it would have been obvious to one of ordinary skill in the art at the time the invention was made to remove the barrier layer and the seed layer from selected areas and to deposit the conductor by a selective deposition process only in those areas left after the removal of the barrier layer and the seed layer in the invention of Havemann et al. for the disclosed intended purpose of Brown et al. of reducing the manufacturing cost, reducing consumption of electroplating solution and CMP consumables, reducing the amount of post-metallization deposition CMP needed and reducing the amount of hazardous effluents as disclosed by Brown et al. in col. 16, lines 42-67 and col. 17, lines 1-24. Furthermore, it would have been within the scope of one of ordinary skill in the art at the time the invention was made that gold may be used as an alternative to copper or aluminum although copper is preferred over gold, and as Brown et al. discloses that the use of gold has been considered in semiconductor interconnections and disclosed examples and preferred embodiments do not constitute a teaching away from a broader disclosure or nonpreferred embodiments.

In re Susi, 440 F.2d 442, 169 USPQ 423 (CCPA 1971). "A known or obvious composition does not become patentable simply because it has been described as somewhat inferior to some other product for the same use." *In re Gurley*, 27 F.3d 551, 554, 31 USPQ2d 1130, 1132 (Fed. Cir. 1994) (The invention was directed to an epoxy impregnated fiber-

reinforced printed circuit material. The applied prior art reference taught a printed circuit material similar to that of the claims but impregnated with polyester-imide resin instead of epoxy. The reference, however, disclosed that epoxy was known for this use, but that epoxy impregnated circuit boards have "relatively acceptable dimensional stability" and "some degree of flexibility," but are inferior to circuit boards impregnated with polyester-imide resins. The court upheld the rejection concluding that applicant's argument that the reference teaches away from using epoxy was insufficient to overcome the rejection since "Gurley asserted no discovery beyond what was known in the art." 27 F.3d at 554, 31 USPQ2d at 1132.).

Regarding claim 31, Havemann et al. discloses that the barrier layer comprises titanium and is deposited to a thickness of between 100 and 200 angstroms, and the barrier layer does not fill the trench. Although the depth of the trench is not disclosed it is taught that the depth is of at least 200 angstroms and that the depth can be varied depending on the interconnection as shown in Fig. 1k of Havemann et al. Furthermore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to vary the depth of the trench, thus varying the depth to which the barrier layer is deposited as there is no statement denoting the criticality of the depth to which the barrier layer is deposited.

"In the case where the claimed ranges "overlap or lie inside ranges disclosed by the prior art" a prima facie case of obviousness exists. In re Wertheim, 541 F.2d 257, 191 USPQ 90 (CCPA 1976); In re Woodruff, 919 F.2d 1575, 16 USPQ2d 1934 (Fed. Cir. 1990) (The prior art taught carbon monoxide concentrations of "about 1-5%" while the claim was limited to "more than 5%." The court held that "about 1-5%" allowed for concentrations slightly above 5% thus the ranges overlapped.)" (MPEP 2144.04)

Regarding claim 32, Havemann et al. discloses in col. 3, lines 31-35 that the barrier layer is deposited by physical vapor deposition.

Regarding claim 34, Havemann et al. discloses a method of forming a conductor that comprises depositing a polymer layer 122(*col. 3, lines 14-17, col. 4, lines 49-65*) over a planarized surface 120(*col. 2, lines 45-47*); etching a trench having a depth on the polymer 122(*col. 3, lines 24-25*); depositing a barrier layer 150 of titanium on the insulator (*col. 3, lines 31-35*); depositing a seed layer of copper 152 directly on the barrier layer (*col. 3, lines 35-40*); depositing a conductor on the seed area by a deposition process (*col. 3, lines 37-40*).

Havemann et al. discloses the claimed invention with the exception of removing the barrier layer and seed layer from selected areas of the oxide layer, using silver on the seed layer and the conductor, and depositing the conductor after removing the barrier layer and the seed layer.

Brown et al. discloses a method of forming a conductor that comprises etching a trench 405 having a depth on an insulator (*col. 6, lines 3-6*); depositing a barrier layer 400A on the insulator (*col. 6, lines 3-6*); depositing a seed layer 400B directly on the barrier layer (*col. 6, lines 3-6*); removing the barrier layer and seed layer from selected areas of the insulator, leaving a seed area (*col. 6, lines 14-23*); and depositing a conductor on the seed area by a selective deposition process after removing the barrier layer and seed layer from selected areas of the insulator wherein the selected areas are directly on a top surface of the insulator (*col. 7, lines 50-59 and Figs. 5F-5H*), and wherein gold,

copper, and silver have been considered as alternatives to aluminum; wherein a seed area is formed by the removal of the barrier and seed layers (*col. 6, lines 14-41*), and the conductor is selectively deposited for the disclosed intended purpose of reducing the manufacturing cost, reducing consumption of electroplating solution and CMP consumables, reducing the amount of post-metallization deposition CMP needed and reducing the amount of hazardous effluents among other advantages as disclosed in *col. 16, lines 42-67*, and *col. 17, lines 1-24*.

Thus, it would have been obvious to one of ordinary skill in the art at the time the invention was made to remove the barrier layer and the seed layer from selected areas and to deposit the conductor by a selective deposition process only in those areas left after the removal of the barrier layer and the seed layer in the invention of Havemann et al. for the disclosed intended purpose of Brown et al. of reducing the manufacturing cost, reducing consumption of electroplating solution and CMP consumables, reducing the amount of post-metallization deposition CMP needed and reducing the amount of hazardous effluents as disclosed by Brown et al. in *col. 16, lines 42-67* and *col. 17, lines 1-24*. Furthermore, it would have been within the scope of one of ordinary skill in the art at the time the invention was made that silver may be used as an alternative to copper or aluminum although copper is preferred over silver, and as Brown et al. discloses that the use of gold has been considered in semiconductor interconnections and disclosed examples and preferred embodiments do not constitute a teaching away from a broader disclosure or nonpreferred embodiments.

In re Susi, 440 F.2d 442, 169 USPQ 423 (CCPA 1971). "A known or obvious composition does not become patentable simply because it has been described as somewhat inferior to some other product for the same use." *In re Gurley*, 27 F.3d 551, 554, 31 USPQ2d 1130, 1132 (Fed. Cir. 1994) (The invention was directed to an epoxy impregnated fiber-reinforced printed circuit material. The applied prior art reference taught a printed circuit material similar to that of the claims but impregnated with polyester-imide resin instead of epoxy. The reference, however, disclosed that epoxy was known for this use, but that epoxy impregnated circuit boards have "relatively acceptable dimensional stability" and "some degree of flexibility," but are inferior to circuit boards impregnated with polyester-imide resins. The court upheld the rejection concluding that applicant's argument that the reference teaches away from using epoxy was insufficient to overcome the rejection since "Gurley asserted no discovery beyond what was known in the art." 27 F.3d at 554, 31 USPQ2d at 1132.).

Regarding claim 35, Havemann et al. discloses that the barrier layer comprising tantalum is deposited to a thickness of between 100 and 200 angstroms, and the barrier layer does not fill the trench. Although the depth of the trench is not disclosed it is taught that the depth is of at least 200 angstroms and that the depth can be varied depending on the interconnection as shown in Fig. 1k of Havemann et al. Furthermore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to vary the depth of the trench, thus varying the depth to which the barrier layer is deposited as there is no statement denoting the criticality of the depth to which the barrier layer is deposited.

"In the case where the claimed ranges "overlap or lie inside ranges disclosed by the prior art" a prima facie case of obviousness exists. In re Wertheim, 541 F.2d 257, 191 USPQ 90 (CCPA 1976); In re Woodruff, 919 F.2d 1575, 16 USPQ2d 1934 (Fed. Cir. 1990) (The prior art taught carbon monoxide concentrations of "about 1-5%" while the claim was limited to "more than 5%." The court held that "about 1-5%" allowed for concentrations slightly above 5% thus the ranges overlapped.)" (MPEP 2144.04)

Regarding claim 36, Havemann et al. discloses in col. 3, lines 31-35 that the barrier layer is deposited by physical vapor deposition.

Regarding claim 38, Havemann et al. discloses a method of forming a conductor that comprises depositing a polymer layer 122(*col. 3, lines 14-17, col. 4, lines 49-65*) over a planarized surface 120(*col. 2, lines 45-47*); etching a trench having a depth on the polymer 122(*col. 3, lines 24-25*); depositing a barrier layer 150 of titanium on the insulator (*col. 3, lines 31-35*); depositing a seed layer of copper 152 directly on the barrier layer (*col. 3, lines 35-40*); depositing a conductor on the seed area by a deposition process (*col. 3, lines 37-40*).

Havemann et al. discloses the claimed invention with the exception of removing the barrier layer and seed layer from selected areas of the insulator, and depositing the conductor by a selective deposition process after removing the barrier layer and the seed layer.

Brown et al. discloses a method of forming a conductor that comprises etching a trench 405 having a depth on an insulator (*col. 6, lines 3-6*); depositing a barrier layer 400A on the insulator (*col. 6, lines 3-6*); depositing a seed layer 400B directly on the barrier layer (*col. 6, lines 3-6*); removing the barrier layer and seed layer from selected

areas of the insulator, leaving a seed area (*col. 6, lines 14-23*); and depositing a conductor on the seed area by a selective deposition process after removing the barrier layer and seed layer from selected areas of the insulator wherein the selected areas are directly on a top surface of the insulator (*col. 7, lines 50-59 and Figs. 5F-5H*), wherein a seed area is formed by the removal of the barrier and seed layers *col. 6, lines 14-41*), and the conductor is selectively deposited for the disclosed intended purpose of reducing the manufacturing cost, reducing consumption of electroplating solution and CMP consumables, reducing the amount of post-metallization deposition CMP needed and reducing the amount of hazardous effluents among other advantages as disclosed in *col. 16, lines 42-67, and col. 17, lines 1-24*.

Thus, it would have been obvious to one of ordinary skill in the art at the time the invention was made to remove the barrier layer and the seed layer from selected areas and to deposit the conductor by a selective deposition process only in those areas left after the removal of the barrier layer and the seed layer in the invention of Havemann et al. for the disclosed intended purpose of Brown et al. of reducing the manufacturing cost, reducing consumption of electroplating solution and CMP consumables, reducing the amount of post-metallization deposition CMP needed and reducing the amount of hazardous effluents as disclosed by Brown et al. in *col. 16, lines 42-67 and col. 17, lines 1-24*.

Regarding claim 39, Havemann et al. discloses that the barrier layer comprises titanium and is deposited to a thickness of between 100 and 200 angstroms, and the

barrier layer does not fill the trench. Although the depth of the trench is not disclosed it is taught that the depth is of at least 200 angstroms and that the depth can be varied depending on the interconnection as shown in Fig. 1k of Havemann et al. Furthermore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to vary the depth of the trench, thus varying the depth to which the barrier layer is deposited as there is no statement denoting the criticality of the depth to which the barrier layer is deposited.

"In the case where the claimed ranges "overlap or lie inside ranges disclosed by the prior art" a prima facie case of obviousness exists. In re Wertheim, 541 F.2d 257, 191 USPQ 90 (CCPA 1976); In re Woodruff, 919 F.2d 1575, 16 USPQ2d 1934 (Fed. Cir. 1990) (The prior art taught carbon monoxide concentrations of "about 1-5%" while the claim was limited to "more than 5%." The court held that "about 1-5%" allowed for concentrations slightly above 5% thus the ranges overlapped.)" (MPEP 2144.04)

Regarding claim 40, Havemann et al. discloses in col. 3, lines 31-35 that the barrier layer is deposited by physical vapor deposition.

Regarding claim 41, Havemann et al. discloses in col. 3, lines 35-40 that the copper is deposited by electroplating.

Regarding claim 56, Havemann et al. discloses a method of forming a conductor that comprises depositing an oxide layer 122 (*col. 3, lines 14-17*) over a planarized surface 120(*col. 2, lines 45-47*); etching a trench on the oxide layer 122(*col. 3, lines 24-25*); depositing a barrier layer 150 of tantalum nitride (*col. 3, lines 31-35*); depositing a seed layer 152 of copper directly on the barrier layer of tantalum nitride oxide layer without a layer between the seed layer of copper and the barrier layer of tantalum nitride 150

(col. 3, lines 35-40); depositing a conductor on the seed area by a deposition process (col. 3, lines 37-40), and depositing a barrier layer above the conductor after removing the barrier layer and seed layer from selected areas of the oxide layer (col. 4, lines 32-35), wherein Havemann et al. teaches that tantalum nitride can be used instead of titanium nitride.

Havemann et al. discloses the claimed invention with the exception of removing the barrier layer and seed layer from selected areas of the oxide layer, and depositing the conductor after removing the barrier layer and the seed layer.

Brown et al. discloses a method of forming a conductor that comprises etching a trench 405 having a depth on an insulator (col. 6, lines 3-6); depositing a barrier layer 400A on the insulator (col. 6, lines 3-6); depositing a seed layer 400B directly on the barrier layer (col. 6, lines 3-6); removing the barrier layer and seed layer from selected areas of the insulator, leaving a seed area (col. 6, lines 14-23); and depositing a conductor on the seed area by a selective deposition process after removing the barrier layer and seed layer from selected areas of the insulator wherein the selected areas are directly on a top surface of the insulator (col. 7, lines 50-59 and Figs. 5F-5H), wherein a seed area is formed by the removal of the barrier and seed layers (col. 6, lines 14-41), and the conductor is selectively deposited for the disclosed intended purpose of reducing the manufacturing cost, reducing consumption of electroplating solution and CMP consumables, reducing the amount of post-metallization deposition CMP needed and

reducing the amount of hazardous effluents among other advantages as disclosed in col. 16, lines 42-67, and col. 17, lines 1-24.

Thus, it would have been obvious to one of ordinary skill in the art at the time the invention was made to remove the barrier layer and the seed layer from selected areas and to deposit the conductor by a selective deposition process only in those areas left after the removal of the barrier layer and the seed layer in the invention of Havemann et al. for the disclosed intended purpose of Brown et al. of reducing the manufacturing cost, reducing consumption of electroplating solution and CMP consumables, reducing the amount of post-metallization deposition CMP needed and reducing the amount of hazardous effluents as disclosed by Brown et al. in col. 16, lines 42-67 and col. 17, lines 1-24.

Regarding claims 57 and 58, Havemann et al. discloses that the barrier layer of tantalum nitride and is deposited to a thickness of between 100 and 200 angstroms, and that the copper seed layer is deposited over the barrier layer and does not fill the trench. Although the depth of the trench is not disclosed it is taught that the depth is of at least 200 angstroms and that the depth can be varied depending on the interconnection as shown in Fig. 1k of Havemann et al. Furthermore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to vary the thickness of the layers, thus varying the depth to which the barrier layer is deposited as there is no statement denoting the criticality of the thickness of the barrier layer and the seed layer.

"In the case where the claimed ranges "overlap or lie inside ranges disclosed by the prior art" a prima facie case of obviousness exists. In re Wertheim, 541 F.2d 257, 191 USPQ 90 (CCPA 1976); In re Woodruff, 919 F.2d 1575, 16 USPQ2d 1934 (Fed. Cir. 1990) (The prior art taught carbon monoxide concentrations of "about 1-5%" while the claim was limited to "more than 5%." The court held that "about 1-5%" allowed for concentrations slightly above 5% thus the ranges overlapped.)" (MPEP 2144.04)

Regarding claims 59, 60, 62, Havemann et al. discloses that the barrier layer of tantalum nitride and the copper seed layer are deposited by either of physical vapor deposition and chemical vapor deposition.

Regarding claim 61, Havemann et al. discloses that the barrier layer comprises titanium and is deposited to a thickness of between 100 and 200 angstroms, and the barrier layer does not fill the trench. Although the depth of the trench is not disclosed it is taught that the depth is of at least 200 angstroms and that the depth can be varied depending on the interconnection as shown in Fig. 1k of Havemann et al. Furthermore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to vary the depth of the trench, thus varying the depth to which the barrier layer is deposited as there is no statement denoting the criticality of the depth to which the barrier layer is deposited.

"In the case where the claimed ranges "overlap or lie inside ranges disclosed by the prior art" a prima facie case of obviousness exists. In re Wertheim, 541 F.2d 257, 191 USPQ 90 (CCPA 1976); In re Woodruff, 919 F.2d 1575, 16 USPQ2d 1934 (Fed. Cir. 1990) (The prior art taught carbon monoxide concentrations of "about 1-5%" while the claim was limited to "more than 5%." The court held that "about 1-5%" allowed for concentrations slightly above 5% thus the ranges overlapped.)" (MPEP 2144.04)

Regarding claim 63, Havemann et al. discloses that the seed layer of copper is deposited to a thickness that does not fill the trench. Although the depth of the trench is not disclosed it is taught that the depth is of at least 200 angstroms as this is the thickness of the underlying barrier layer and that the depth can be varied depending on the interconnection as shown in Fig. 1k of Havemann et al. Furthermore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to vary the depth of the trench, thus varying the depth to which the seed layer is deposited as there is no statement denoting the criticality of the depth to which the seed layer is deposited.

"In the case where the claimed ranges "overlap or lie inside ranges disclosed by the prior art" a prima facie case of obviousness exists. In re Wertheim, 541 F.2d 257, 191 USPQ 90 (CCPA 1976); In re Woodruff, 919 F.2d 1575, 16 USPQ2d 1934 (Fed. Cir. 1990) (The prior art taught carbon monoxide concentrations of "about 1-5%" while the claim was limited to "more than 5%." The court held that "about 1-5%" allowed for concentrations slightly above 5% thus the ranges overlapped.)" (MPEP 2144.04)

Regarding claim 64, Havemann et al. discloses that the barrier layer of tantalum nitride is deposited to a thickness of between about 100 and 200 angstroms and that does not fill the trench. Although the depth of the trench is not disclosed it is taught that the depth is of at least 200 angstroms as this is the thickness of the barrier layer and that the depth can be varied depending on the interconnection as shown in Fig. 1k of Havemann et al. Furthermore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to vary the depth of the trench, thus varying

the depth to which the barrier layer is deposited as there is no statement denoting the criticality of the depth to which the barrier layer is deposited.

"In the case where the claimed ranges "overlap or lie inside ranges disclosed by the prior art" a prima facie case of obviousness exists. In re Wertheim, 541 F.2d 257, 191 USPQ 90 (CCPA 1976); In re Woodruff, 919 F.2d 1575, 16 USPQ2d 1934 (Fed. Cir. 1990) (The prior art taught carbon monoxide concentrations of "about 1-5%" while the claim was limited to "more than 5%." The court held that "about 1-5%" allowed for concentrations slightly above 5% thus the ranges overlapped.)" (MPEP 2144.04)

Regarding claim 65, Havemann et al. discloses that the oxide layer 122 may be a silicon dioxide layer.

Regarding claim 66, Havemann et al. discloses that the oxide layer 122 may be a fluorinated silicon oxide layer.

Regarding claim 67, Havemann et al. discloses a method of forming a conductor that comprises depositing an oxide layer 122 (*col. 3, lines 14-17*) over a planarized surface 120(*col. 2, lines 45-47*); etching a trench on the oxide layer 122(*col. 3, lines 24-25*); depositing a barrier layer 150 of tantalum nitride (*col. 3, lines 31-35*); depositing a seed layer 152 of copper directly on the barrier layer of tantalum nitride oxide layer without a layer between the seed layer of copper and the barrier layer of tantalum nitride 150 (*col. 3, lines 35-40*); depositing a conductor on the seed area by a deposition process(*col. 3, lines 37-40*), and depositing a barrier layer above the conductor after removing the barrier layer and seed layer from selected areas of the oxide layer (*col. 4, lines 32-35*), wherein Havemann et al. teaches that tantalum nitride can be used instead of titanium nitride.

Havemann et al. discloses the claimed invention with the exception of removing the barrier layer and seed layer from selected areas of the oxide layer, and depositing the conductor after removing the barrier layer and the seed layer.

Brown et al. discloses a method of forming a conductor that comprises etching a trench 405 having a depth on an insulator (*col. 6, lines 3-6*); depositing a barrier layer 400A on the insulator (*col. 6, lines 3-6*); depositing a seed layer 400B directly on the barrier layer (*col. 6, lines 3-6*); removing the barrier layer and seed layer from selected areas of the insulator, leaving a seed area (*col. 6, lines 14-23*); and depositing a conductor on the seed area by a selective deposition process after removing the barrier layer and seed layer from selected areas of the insulator wherein the selected areas are directly on a top surface of the insulator (*col. 7, lines 50-59 and Figs. 5F-5H*), wherein a seed area is formed by the removal of the barrier and seed layers (*col. 6, lines 14-41*), and the conductor is selectively deposited for the disclosed intended purpose of reducing the manufacturing cost, reducing consumption of electroplating solution and CMP consumables, reducing the amount of post-metallization deposition CMP needed and reducing the amount of hazardous effluents among other advantages as disclosed in *col. 16, lines 42-67, and col. 17, lines 1-24*.

Thus, it would have been obvious to one of ordinary skill in the art at the time the invention was made to remove the barrier layer and the seed layer from selected areas and to deposit the conductor by a selective deposition process only in those areas left after the removal of the barrier layer and the seed layer in the invention of

Havemann et al. for the disclosed intended purpose of Brown et al. of reducing the manufacturing cost, reducing consumption of electroplating solution and CMP consumables, reducing the amount of post-metallization deposition CMP needed and reducing the amount of hazardous effluents as disclosed by Brown et al. in col. 16, lines 42-67 and col. 17, lines 1-24.

Regarding claims 68 and 69, Havemann et al. discloses that the barrier layer of tantalum nitride and is deposited to a thickness of between 100 and 200 angstroms, and that the copper seed layer is deposited over the barrier layer and does not fill the trench. Although the depth of the trench is not disclosed it is taught that the depth is of at least 200 angstroms and that the depth can be varied depending on the interconnection as shown in Fig. 1k of Havemann et al. Furthermore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to vary the thickness of the layers, thus varying the depth to which the barrier layer is deposited as there is no statement denoting the criticality of the thickness of the barrier layer and the seed layer.

"In the case where the claimed ranges "overlap or lie inside ranges disclosed by the prior art" a prima facie case of obviousness exists. In re Wertheim, 541 F.2d 257, 191 USPQ 90 (CCPA 1976); In re Woodruff, 919 F.2d 1575, 16 USPQ2d 1934 (Fed. Cir. 1990) (The prior art taught carbon monoxide concentrations of "about 1-5%" while the claim was limited to "more than 5%." The court held that "about 1-5%" allowed for concentrations slightly above 5% thus the ranges overlapped.)" (MPEP 2144.04)

Regarding claims 70, 72, 73, Havemann et al. discloses that the barrier layer of tantalum nitride and the copper seed layer are deposited by either of physical vapor deposition and chemical vapor deposition.

Regarding claim 71, Havemann et al. discloses that the barrier layer comprises titanium and is deposited to a thickness of between 100 and 200 angstroms, and the barrier layer does not fill the trench. Although the depth of the trench is not disclosed it is taught that the depth is of at least 200 angstroms and that the depth can be varied depending on the interconnection as shown in Fig. 1k of Havemann et al. Furthermore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to vary the depth of the trench, thus varying the depth to which the barrier layer is deposited as there is no statement denoting the criticality of the depth to which the barrier layer is deposited.

"In the case where the claimed ranges "overlap or lie inside ranges disclosed by the prior art" a prima facie case of obviousness exists. In re Wertheim, 541 F.2d 257, 191 USPQ 90 (CCPA 1976); In re Woodruff, 919 F.2d 1575, 16 USPQ2d 1934 (Fed. Cir. 1990) (The prior art taught carbon monoxide concentrations of "about 1-5%" while the claim was limited to "more than 5%." The court held that "about 1-5%" allowed for concentrations slightly above 5% thus the ranges overlapped.)" (MPEP 2144.04)

Regarding claim 74, Havemann et al. discloses that the seed layer of copper is deposited to a thickness that does not fill the trench. Although the depth of the trench is not disclosed it is taught that the depth is of at least 200 angstroms as this is the thickness of the underlying barrier layer and that the depth can be varied depending on the interconnection as shown in Fig. 1k of Havemann et al. Furthermore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to vary the depth of the trench, thus varying the depth to which the seed layer is deposited

as there is no statement denoting the criticality of the depth to which the seed layer is deposited.

"In the case where the claimed ranges "overlap or lie inside ranges disclosed by the prior art" a prima facie case of obviousness exists. In re Wertheim, 541 F.2d 257, 191 USPQ 90 (CCPA 1976); In re Woodruff, 919 F.2d 1575, 16 USPQ2d 1934 (Fed. Cir. 1990) (The prior art taught carbon monoxide concentrations of "about 1-5%" while the claim was limited to "more than 5%." The court held that "about 1-5%" allowed for concentrations slightly above 5% thus the ranges overlapped.)" (MPEP 2144.04)

Regarding claim 75, Havemann et al. discloses that the barrier layer of tantalum nitride is deposited to a thickness of between about 100 and 200 angstroms and that does not fill a trench. Although the depth of the trench is not disclosed it is taught that the depth is of at least 200 angstroms as this is the thickness of the barrier layer and that the depth can be varied depending on the interconnection as shown in Fig. 1k of Havemann et al. Furthermore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to vary the depth of the trench, thus varying the depth to which the barrier layer is deposited as there is no statement denoting the criticality of the depth to which the barrier layer is deposited.

"In the case where the claimed ranges "overlap or lie inside ranges disclosed by the prior art" a prima facie case of obviousness exists. In re Wertheim, 541 F.2d 257, 191 USPQ 90 (CCPA 1976); In re Woodruff, 919 F.2d 1575, 16 USPQ2d 1934 (Fed. Cir. 1990) (The prior art taught carbon monoxide concentrations of "about 1-5%" while the claim was limited to "more than 5%." The court held that "about 1-5%" allowed for concentrations slightly above 5% thus the ranges overlapped.)" (MPEP 2144.04)

Regarding claim 76, Havemann et al. discloses that the oxide layer 122 may be a silicon dioxide layer.

Regarding claim 77, Havemann et al. discloses that the oxide layer 122 may be a fluorinated silicon oxide layer.

Regarding claim 186, Havemann et al. discloses a method that comprises depositing an insulator layer 122 (*col. 3, lines 14-17*) over a substrate having at least one device 110(*col. 2, lines 45-47*); depositing a diffusion barrier layer 126 over the insulator layer 122; planarizing a surface of the diffusion barrier layer 126; depositing a different insulator layer 170 over the planarized surface of the diffusion barrier layer 126; fabricating a connector 178 in the different insulator layer 170, wherein fabricating the connector includes etching a trench on the insulator layer 170; depositing a barrier layer; depositing a seed layer directly on the barrier layer (*col. 4, lines 1-35*); depositing a conductor on the seed area by a deposition process(*col. 3, lines 37-40*).

Havemann et al. discloses the claimed invention with the exception of removing the barrier layer and seed layer from selected areas of the oxide layer, and depositing the conductor after removing the barrier layer and the seed layer.

Brown et al. discloses a method of forming a conductor that comprises etching a trench 405 having a depth on an insulator (*col. 6, lines 3-6*); depositing a barrier layer 400A on the insulator (*col. 6, lines 3-6*); depositing a seed layer 400B directly on the barrier layer (*col. 6, lines 3-6*); removing the barrier layer and seed layer from selected areas of the insulator; leaving a seed area (*col. 6, lines 14-23*); and depositing a conductor on the seed area by a selective deposition process after removing the barrier layer and seed layer from selected areas of the insulator wherein the selected areas are directly on

a top surface of the insulator (*col. 7, lines 50-59 and Figs. 5F-5H*), wherein a seed area is formed by the removal of the barrier and seed layers (*col. 6, lines 14-41*), and the conductor is selectively deposited for the disclosed intended purpose of reducing the manufacturing cost, reducing consumption of electroplating solution and CMP consumables, reducing the amount of post-metallization deposition CMP needed and reducing the amount of hazardous effluents among other advantages as disclosed in *col. 16, lines 42-67, and col. 17, lines 1-24*.

Thus, it would have been obvious to one of ordinary skill in the art at the time the invention was made to remove the barrier layer and the seed layer from selected areas and to deposit the conductor by a selective deposition process only in those areas left after the removal of the barrier layer and the seed layer in the invention of Havemann et al. for the disclosed intended purpose of Brown et al. of reducing the manufacturing cost, reducing consumption of electroplating solution and CMP consumables, reducing the amount of post-metallization deposition CMP needed and reducing the amount of hazardous effluents as disclosed by Brown et al. in *col. 16, lines 42-67 and col. 17, lines 1-24*.

Regarding claim 187, Havemann et al. discloses that the seed layer comprises copper.

Regarding claim 188, Havemann et al. discloses that the deposition of the barrier layer is by physical vapor deposition.

Regarding claim 189, Havemann et al. discloses that the deposition of a different insulator layer includes depositing an oxide layer over the planarized surface as disclosed in col. 3, lines 58-65.

3. Claims 42-44, and 50-55 are rejected under 35 U.S.C. 103(a) as being unpatentable over Havemann et al. in view of Brown et al. and Ting et al..

Regarding claim 42, Havemann et al. discloses a method of forming a conductor that comprises depositing an oxide layer 122 (*col. 3, lines 14-17*) over a planarized surface 120(*col. 2, lines 45-47*); etching a trench on the oxide layer 122(*col. 3, lines 24-25*); depositing a barrier layer 150 of titanium on the oxide layer 122 (*col. 3, lines 31-35*); depositing a seed layer 152 of copper on the oxide layer (*col. 3, lines 35-40*); depositing a conductor on the seed area by a deposition process(*col. 3, lines 37-40*).

Havemann et al. discloses the claimed invention with the exception of removing the barrier layer and seed layer from selected areas of the oxide layer, using aluminum-copper on the seed layer and the conductor, and depositing the conductor after removing the barrier layer and the seed layer.

Brown et al. discloses a method of forming a conductor that comprises etching a trench 405 having a depth on an insulator (*col. 6, lines 3-6*); depositing a barrier layer 400A on the insulator (*col. 6, lines 3-6*); depositing a seed layer 400B directly on the barrier layer (*col. 6, lines 3-6*); removing the barrier layer and seed layer from selected areas of the insulator, leaving a seed area (*col. 6, lines 14-23*); and depositing a conductor on the seed area by a selective deposition process after removing the barrier layer and

seed layer from selected areas of the insulator wherein the selected areas are directly on a top surface of the insulator (*col. 7, lines 50-59 and Figs. 5F-5H*), and wherein gold, copper, and silver have been considered as alternatives to aluminum; wherein a seed area is formed by the removal of the barrier and seed layers (*col. 6, lines 14-41*), and the conductor is selectively deposited for the disclosed intended purpose of reducing the manufacturing cost, reducing consumption of electroplating solution and CMP consumables, reducing the amount of post-metallization deposition CMP needed and reducing the amount of hazardous effluents among other advantages as disclosed in *col. 16, lines 42-67, and col. 17, lines 1-24*.

Ting et al. discloses a method of forming a conductor that comprises a seed layer of aluminum-copper, the step of depositing copper on the seed layer that comprises depositing aluminum on the seed area by selective CVD, wherein the aluminum-copper layer is used as an alternative to a copper layer, and furthermore Ting et al. discloses that copper, gold, silver and aluminum are alternative materials for forming conductors. It would have been obvious to one having ordinary skill in the art at the time the invention was made to an aluminum-copper seed layer instead of a copper seed layer and to form a conductor comprising any of gold, silver, aluminum or copper, since it has been held to be within the general skill of a worker in the art to select a known material on the basis of its suitability for the intended use as a matter of obvious design choice. *In re Leshin*, 125 USPQ 416.

Thus, it would have been obvious to one of ordinary skill in the art at the time the invention was made to remove the barrier layer and the seed layer from selected areas and to deposit the conductor by a selective deposition process only in those areas left after the removal of the barrier layer and the seed layer in the invention of Havemann et al. for the disclosed intended purpose of Brown et al. of reducing the manufacturing cost, reducing consumption of electroplating solution and CMP consumables, reducing the amount of post-metallization deposition CMP needed and reducing the amount of hazardous effluents as disclosed by Brown et al. in col. 16, lines 42-67 and col. 17, lines 1-24. Furthermore, it would have been within the scope of one of ordinary skill in the art at the time the invention was made that aluminum-copper may be used as an alternative to copper or aluminum, and as Brown et al. discloses that the use of aluminum and copper has been considered in semiconductor interconnections and Ting et al. discloses the use of aluminum-copper as a seed layer for copper conductors and disclosed examples and preferred embodiments do not constitute a teaching away from a broader disclosure or nonpreferred embodiments.

In re Susi, 440 F.2d 442, 169 USPQ 423 (CCPA 1971). "A known or obvious composition does not become patentable simply because it has been described as somewhat inferior to some other product for the same use." *In re Gurley*, 27 F.3d 551, 554, 31 USPQ2d 1130, 1132 (Fed. Cir. 1994) (The invention was directed to an epoxy impregnated fiber-reinforced printed circuit material. The applied prior art reference taught a printed circuit material similar to that of the claims but impregnated with polyester-imide resin instead of

epoxy. The reference, however, disclosed that epoxy was known for this use, but that epoxy impregnated circuit boards have "relatively acceptable dimensional stability" and "some degree of flexibility," but are inferior to circuit boards impregnated with polyester-imide resins. The court upheld the rejection concluding that applicant's argument that the reference teaches away from using epoxy was insufficient to overcome the rejection since "Gurley asserted no discovery beyond what was known in the art." 27 F.3d at 554, 31 USPQ2d at 1132.).

Regarding claim 43, Havemann et al. discloses that the barrier layer comprising titanium is deposited to a thickness of between 100 and 200 angstroms, and the barrier layer does not fill the trench. Although the depth of the trench is not disclosed it is taught that the depth is of at least 200 angstroms and that the depth can be varied depending on the interconnection as shown in Fig. 1k of Havemann et al. Furthermore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to vary the depth of the trench, thus varying the depth to which the barrier layer is deposited as there is no statement denoting the criticality of the depth to which the barrier layer is deposited.

"In the case where the claimed ranges "overlap or lie inside ranges disclosed by the prior art" a prima facie case of obviousness exists. In re Wertheim, 541 F.2d 257, 191 USPQ 90 (CCPA 1976); In re Woodruff, 919 F.2d 1575, 16 USPQ2d 1934 (Fed. Cir. 1990) (The prior art taught carbon monoxide concentrations of "about 1-5%" while the claim was limited to "more than 5%." The court held that "about 1-5%" allowed for concentrations slightly above 5% thus the ranges overlapped.)" (MPEP 2144.04)

Regarding claim 44, Havemann et al. discloses in col. 3, lines 31-35 that the barrier layer is deposited by physical vapor deposition.

Regarding claim 50, Havemann et al. discloses a method of forming a conductor that comprises depositing an oxide layer 122 (*col. 3, lines 14-17*) over a planarized surface 120 (*col. 2, lines 45-47*); etching a trench on the oxide layer 122 (*col. 3, lines 24-25*); depositing a barrier layer 150 of titanium on the oxide layer 122 (*col. 3, lines 31-35*); depositing a seed layer 152 of copper on the oxide layer (*col. 3, lines 35-40*); depositing a conductor on the seed area by a deposition process (*col. 3, lines 37-40*).

Havemann et al. discloses the claimed invention with the exception of removing the barrier layer and seed layer from selected areas of the oxide layer, using aluminum-copper on the seed layer and the conductor, and depositing the conductor after removing the barrier layer and the seed layer.

Brown et al. discloses a method of forming a conductor that comprises etching a trench 405 having a depth on an insulator (*col. 6, lines 3-6*); depositing a barrier layer 400A on the insulator (*col. 6, lines 3-6*); depositing a seed layer 400B directly on the barrier layer (*col. 6, lines 3-6*); removing the barrier layer and seed layer from selected areas of the insulator, leaving a seed area (*col. 6, lines 14-23*); and depositing a conductor on the seed area by a selective deposition process after removing the barrier layer and seed layer from selected areas of the insulator wherein the selected areas are directly on a top surface of the insulator (*col. 7, lines 50-59 and Figs. 5F-5H*), and wherein gold, copper, and silver have been considered as alternatives to aluminum; wherein a seed area is formed by the removal of the barrier and seed layers (*col. 6, lines 14-41*), and the conductor is selectively deposited for the disclosed intended purpose of reducing the

manufacturing cost, reducing consumption of electroplating solution and CMP consumables, reducing the amount of post-metallization deposition CMP needed and reducing the amount of hazardous effluents among other advantages as disclosed in col. 16, lines 42-67, and col. 17, lines 1-24.

Ting et al. discloses a method of forming a conductor that comprises a seed layer of aluminum-copper, the step of depositing copper on the seed layer that comprises depositing aluminum on the seed area by selective CVD, wherein the aluminum-copper layer is used as an alternative to a copper layer, and furthermore Ting et al. discloses that copper, gold, silver and aluminum are alternative materials for forming conductors. It would have been obvious to one having ordinary skill in the art at the time the invention was made to an aluminum-copper seed layer instead of a copper seed layer and to form a conductor comprising any of gold, silver, aluminum or copper, since it has been held to be within the general skill of a worker in the art to select a known material on the basis of its suitability for the intended use as a matter of obvious design choice. *In re Leshin*, 125 USPQ 416.

Thus, it would have been obvious to one of ordinary skill in the art at the time the invention was made to remove the barrier layer and the seed layer from selected areas and to deposit the conductor by a selective deposition process only in those areas left after the removal of the barrier layer and the seed layer in the invention of Havemann et al. for the disclosed intended purpose of Brown et al. of reducing the manufacturing cost, reducing consumption of electroplating solution and CMP

consumables, reducing the amount of post-metallization deposition CMP needed and reducing the amount of hazardous effluents as disclosed by Brown et al. in col. 16, lines 42-67 and col. 17, lines 1-24. Furthermore, it would have been within the scope of one of ordinary skill in the art at the time the invention was made that aluminum-copper may be used as an alternative to copper seed layers as Ting et al. discloses the use of aluminum-copper as a seed layer for copper conductors, and to use aluminum for the conductor as Brown et al. discloses that the use of aluminum and copper has been considered in semiconductor interconnections and disclosed examples and preferred embodiments do not constitute a teaching away from a broader disclosure or nonpreferred embodiments.

In re Susi, 440 F.2d 442, 169 USPQ 423 (CCPA 1971). "A known or obvious composition does not become patentable simply because it has been described as somewhat inferior to some other product for the same use." *In re Gurley*, 27 F.3d 551, 554, 31 USPQ2d 1130, 1132 (Fed. Cir. 1994) (The invention was directed to an epoxy impregnated fiber-reinforced printed circuit material. The applied prior art reference taught a printed circuit material similar to that of the claims but impregnated with polyester-imide resin instead of epoxy. The reference, however, disclosed that epoxy was known for this use, but that epoxy impregnated circuit boards have "relatively acceptable dimensional stability" and "some degree of flexibility," but are inferior to circuit boards impregnated with polyester-imide resins. The court upheld the rejection concluding that applicant's argument that the reference teaches away

from using epoxy was insufficient to overcome the rejection since "Gurley asserted no discovery beyond what was known in the art." 27 F.3d at 554, 31 USPQ2d at 1132.).

Regarding claim 51, Havemann et al. discloses that the barrier layer comprising titanium is deposited to a thickness of between 100 and 200 angstroms, and the barrier layer does not fill the trench. Although the depth of the trench is not disclosed it is taught that the depth is of at least 200 angstroms and that the depth can be varied depending on the interconnection as shown in Fig. 1k of Havemann et al. Furthermore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to vary the depth of the trench, thus varying the depth to which the barrier layer is deposited as there is no statement denoting the criticality of the depth to which the barrier layer is deposited.

"In the case where the claimed ranges "overlap or lie inside ranges disclosed by the prior art" a prima facie case of obviousness exists. In re Wertheim, 541 F.2d 257, 191 USPQ 90 (CCPA 1976); In re Woodruff, 919 F.2d 1575, 16 USPQ2d 1934 (Fed. Cir. 1990) (The prior art taught carbon monoxide concentrations of "about 1-5%" while the claim was limited to "more than 5%." The court held that "about 1-5%" allowed for concentrations slightly above 5% thus the ranges overlapped.)" (MPEP 2144.04)

Regarding claim 52, Havemann et al. discloses in col. 3, lines 31-35 that the barrier layer is deposited by physical vapor deposition.

Regarding claims 53 and 54, Havemann et al. as modified by Ting et al. discloses depositing aluminum on the seed area by selective CVD, and the deposition of an aluminum copper seed layer by CVD.

Regarding claim 55, Havemann et al. discloses that the conductor is deposited in an amount sufficient to fill the trench.

4. Claims 18, 22, 26, 33 and 37, are rejected under 35 U.S.C. 103(a) as being unpatentable over Havemann et al. in view of Brown et al. as applied to claims 1-7, 12-17, 19-21, 23-25, 27-32, 34-36, 38-41, 56-77 above, and further in view of Ting et al. (U. S. Pat. 5,969,422).

Havemann et al., as modified by Brown et al. above, discloses the claimed invention with the exception of the seed layer being formed of aluminum-copper, and the conductor being gold, silver or aluminum and being deposited by electroless plating.

Ting et al. discloses a method of forming a conductor that comprises a seed layer of aluminum-copper, the step of depositing copper on the seed layer that comprises depositing aluminum on the seed area by selective CVD, wherein the aluminum-copper layer is used as an alternative to a copper layer, and furthermore Ting et al. discloses that copper, gold, silver and aluminum are alternative materials for forming conductors. It would have been obvious to one having ordinary skill in the art at the time the invention was made to an aluminum-copper seed layer instead of a copper seed layer and to form a conductor comprising any of gold, silver, aluminum or copper, since it has been held to be within the general skill of a worker in the art to select a known material on the basis of its suitability for the intended use as a matter of obvious design choice. *In re Leshin*, 125 USPQ 416.

Allowable Subject Matter

5. Claims 45-49 are allowed.

Response to Arguments

6. Applicant's arguments filed 11/29/04 have been fully considered but they are not persuasive.

Regarding applicant's argument that there is no motivation to combine the teachings of Brown et al. and Havemann et al. it is noted that the motivation to combine is clearly disclosed by Brown et al. in extent in col. 16, lines 42-67, and in col. 17, lines 1-24, where it is taught that the removal of the barrier and seed layers prior to the deposition of the conductor, and the selective deposition of the conductor is desirable for the benefits listed below:

"Any of the above disclosed embodiments of a method for selectively electrochemically depositing copper according to the present invention enables a copper layer to be selectively deposited only to desired areas. This decreases the cost of the raw materials and the amount of the cost of the raw materials and the amount of processing needed to remove the copper from undesired areas when compared to conventional dual-damascene copper process flows, as shown in FIGS. 2A-2E, and conventional single-damascene copper process flows, as shown in FIGS. 1A-1E. These conventional processes entail electroplating a copper layer across the entire conductive surface. By contrast, selective copper deposition methods, as in the above-disclosed embodiments of a method for selectively electrochemically depositing copper according to the present invention, lower manufacturing costs. Manufacturing costs are lowered by increasing throughput, reducing consumption of electroplating solution and CMP consumables, reducing the amount of post-metallization-deposition CMP needed and reducing the amount of hazardous effluents at both the copper deposition and CMP steps.

Further, conventional selective copper deposition methods, as shown in FIGS. 3A-3E, face the problems of being limited by the conductive properties of barrier layer

320 and of having the difficulty of removing the dielectric material mask 325 from contact openings 310. These problems arise because the barrier layer 320 is used as a conductive coupling between contact openings 310, and because the dielectric material mask 325 is formed after contact openings 310 have been etched. These problems tend to increase the complexity and costs of the manufacturing process and decrease throughput.

By contrast, in any of the above-disclosed embodiments of a method for selectively electrochemically depositing copper according to the present invention, because the barrier metal and copper seed layers selectively formed only in the openings are conductively coupled to a conductive layer, the conductive properties of the barrier metal and copper seed layers between the openings are not limiting. Furthermore, in any of the above-disclosed embodiments of a method for selectively electrochemically depositing copper according to the present invention, there is no formation or deposition of a photoresist or masking material after openings have been formed or etched. Finally, in any of the above-disclosed embodiments of a method for selectively electrochemically depositing copper according to the present invention, it is not necessary to etch the barrier or seed layers, which can be extremely difficult and time consuming. These differences contribute to decreasing the complexity and costs of the manufacturing process and increasing throughput."

Thus there is a motivation to combine that would be obvious to one of ordinary skill in the art.

Regarding applicant's argument that neither Havemann et al. nor Brown et al. disclose removing the barrier and seed layers *from* selected areas of the insulator and that wherein the selected areas are directly on a top surface of the insulator, oxide or polymer layer, it is noted that the barrier and seed layers are removed from a top surface of the insulator as shown in Figs. 5F-5H, and as disclosed in col. 8, lines 59-67 where the photomask is removed prior to the deposition of the barrier layer and the seed layer, hence the barrier layer and the seed layer are formed directly on the insulating layer and the selected areas are directly on a top surface of the insulator, and

since the method of Brown et al. results in removal of the barrier and seed layers from selected areas of the insulator.

Regarding applicants argument that Brown et al. discloses that it is not necessary to remove the barrier material and the seed layer, and that because of this the combination of Havemann et al. and Brown et al. is contradicted, it is noted that the primary purpose of Brown et al is to selectively deposit copper, and that Brown et al. refers in that complete disclosure of col. 17, lines 6-24 to the embodiments where the barrier material and the seed layer are selectively deposited as well, and when they are selectively deposited, it would only include the opening and any etching would be indeed time-consuming, extremely difficult and rendered unnecessary by the selective deposition.

Regarding applicants argument about the Examine/s position that Brown et al. discloses that gold, silver and copper are alternatives to aluminum, applicant is directed to Brown et al.'s col. 1, lines 20-45. Furthermore, Ting et al. teaches that gold, silver, and copper among others are well known and interchangeably used in conductor manufacturing as disclosed in col. 4, lines 54-65, although in that instance the materials are suggested for seed layers.